

Water and energy

Proving the effectiveness of conduit hydropower

A completed Water Research Commission (WRC) project has successfully tested conduit hydropower at pilot scale in South Africa.

Background

Energy is the lifeblood of worldwide economic and social development. When considering the current status of global energy shortages, the emphasis to reduce CO₂ emissions, development of alternative energy generation methods and the growing energy consumption, it is clear that there is a need to change the way energy is created and used.

The demand for energy increases continuously and those demands need to be met in order to stimulate worldwide development. Renewable energy is the way of the future and the potential for its development is of great magnitude.

South Africa is facing an energy crisis which places additional importance on harvesting all available feasible renewable energies. While the country is not particularly well endowed with hydropower conditions, large quantities of raw and potable water are conveyed daily under either pressurised or gravity conditions over large distances and elevations.

Previous WRC study

An initial scoping investigation by the WRC and the University of Pretoria highlighted the potential of hydropower generation at the inlets to storage reservoirs. In South Africa there are 284 municipalities and several water supply utilities and mines, all owning and operating gravity water supply distribution systems which could be considered for small, minim micro and pico scale hydropower installations.

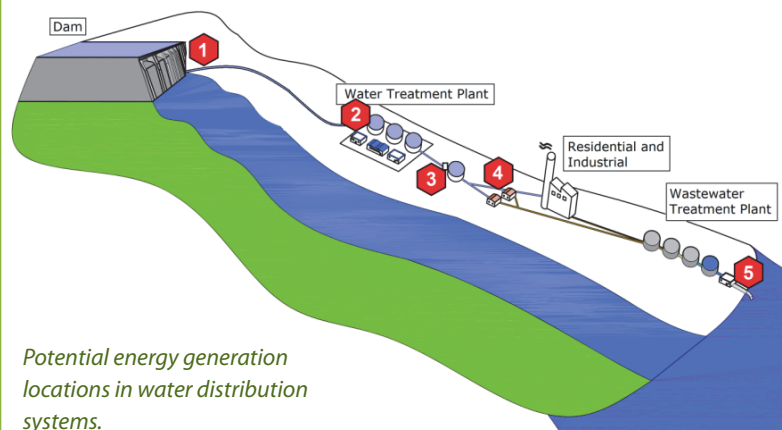
Most of these water supply/distribution systems could be equipped with turbines or pumps as turbines, supplementing and reducing the requirements for pressure control valves. The hydro energy may be used onsite, supplied to the national electricity grid or feeding an isolated electricity demand cluster.

There are basically five areas where energy generation can occur in the water supply and distribution system:

- Dam releases into bulk supply lines
- At water treatment works (raw water) – the bulk pipeline from the water source can be tapped
- Potable water – at inlets to service reservoirs where pressure reducing stations are utilised to dissipate the excess energy
- Distribution network – in the distribution network itself where excess energy is dissipated
- Treated effluent – cases where the treated effluent has potential energy based on its elevation above the discharge point.

Pilot plants

The application to install hydroelectric turbines in a water distribution system is fairly new in South Africa, and thus three pilot plants were constructed showcasing several of the intricacies in the development process and to demonstrate the technologies. The research project indicated that it is feasible and technically possible to generate energy from distribution systems.



Conduit Hydropower Pilot Plants

| Name | Owner | Turbine | Installed capacity (kW) | Use | Payback period (months) |
|---------------------|---|-----------|-------------------------|---|-------------------------|
| Pierre van Ryneveld | City of Tshwane Metropolitan Municipality | Crossflow | 14.9 | Islanded – On site only | 96 months |
| Brandkop | Bloemwater | Crossflow | 96 | Islanded – Supplying the Bloemwater head office | 72 months |
| Newlands 2 | Ethekwini Municipality | Pelton | 1 x 2 | Islanded and grid connected | n.a. |

A number of complexities were identified, however. These include low awareness from the general public and many decision-makers about the advantages that hydropower generation has to offer; lack of skilled small contractors to construct civil and mechanical components; high cost of control system; and the regulatory and legislative aspects which appear 'fuzzy', among others.

Conduit hydropower decision support system

It is important to understand the conduit hydropower development process which is different from conventional hydropower development. A decision support system (DSS) that facilitates the development process of a conduit hydropower plant was developed in this latest WRC project.

The DSS assists in evaluation of the site, providing guidance on the data gathering procedure, describes the feasibility/

economic analysis required, and guides the developer through the turbine selection and detail design aspects. A systematic approach must be followed when assessing hydropower potential in a distribution network to ensure that all relevant factors are considered.

The procedure for determining hydropower potential is illustrated through a series of flow diagrams reflecting the different project phases, while a tool developed in Microsoft Excel (called HydroAID) facilitates calculation of all the factors that need consideration.

Further reading:

To order the reports: *Conduit hydropower pilot plants (Report No. TT 596/14)* and *Conduit hydropower development guide (TT 597/14)* contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.